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TRANSIT PREFERENTIAL STREETS PROGRAM

Program Accomplishments 1985 - 1988

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TRANSIT PREFERENTIAL STREETS PROGRAM

PROGRAM ACCOMPLISHMENTS: 1985-1988

The preparation of this report has been financed in part through a grant from the U.S. Department of Transportation, Urban Mass Transportation Administration, under the Urban Mass Transportation Act of 1964, as amended. The contents of this report do not necessarily reflect the official views or policy of the U.S. Department of Transportation.

Prepared by

TRANSIT PREFERENTIAL STREETS COMMITTEE

Department of City Planning
Municipal Railway
Department of Public Works
San Francisco Police Department

May, 1989

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TABLE OF CONTENTS

PAGE

EXECUTIVE SUMMARY....iv

CHAPTER ONE - INTRODUCTION....1

The UMTA Grant....1
TPS Program History....1
The TPS Committee....3
Methodology....3
Overview of Transit Delays in San Francisco....3
Organization of This Report....4

CHAPTER TWO - REDUCING TRANSIT DELAYS THROUGH BUS STOP REDUCTIONS....6

Bus Stop Removal Criteria....7
Data Collection....7
Findings....7
Discussion....9
On-Street Parking Supply Impacts....9
Citizen Participation....10
Public Reaction....10
Conclusions....10

CHAPTER THREE - REDUCING DELAYS CAUSED BY TRAFFIC CONTROL DEVICES....11

Traffic Signal Pre-Emption....11
Coordination of Transit Stops With Traffic Signal Timings....14
Stop Sign Removals....16
Coordination of Transit Stops and Stop Signs....18
Conclusions....20

CHAPTER FOUR - IMPROVING TRANSIT SPEEDS THROUGH PARKING ENFORCEMENT....21

O'Farrell Street Transit Lane Enforcement....21
Stockton Street Truck Loading Zone Enforcement Test....23
Intersection Blockage Enforcement Test....25
Conclusions....29

CHAPTER FIVE - ADDITIONAL TPS ACCOMPLISHMENTS....30

Mission Street Left Turn Prohibitions....30
Stockton Street Permanent Bus Bulb Installations....30
Evaluation of 1982 Measures on Sutter, Post, Geary and O'Farrell Streets.31
Conclusions....33

CHAPTER SIX - CONCLUSIONS AND RECOMMENDATIONS....34

Reducing Transit Delays Through Bus Stop Reductions....34
Reducing Transit Delays Caused by Traffic Control Devices....34
Improving Transit Speeds Through Parking Enforcement....35
Additional Measures to Reduce Transit Delays....35

LIST OF TABLES

PAGE

1 Before-and-After Results of Bus Stop Reduction Program.....8

2 Parking Spaces Gained Through Bus Stop Reductions.....9

3 Before-and-After Impacts of Traffic Signal Pre-emptions.....13

4 Percentage of Buses Delayed by Traffic Signal.....16

5 Streetcar Travel Times Before-and-After Stop Sign Removal.....18

6 Reduction in Bus Travel Time Due to Coordination of Bus Stops and Stop Signs.....20

7 Impacts of Increased Enforcement - O'Farrell Street.....23

8 Impacts of Increased Enforcement - Stockton Street.....25

9 Impacts of Increased Enforcement - Third and Mission Streets.....27

LIST OF FIGURES

PAGE

1 TPS Project Locations....2

2 Typical Muni Speed and Delay Profiles....5

3 Bus Stop Reduction Program - Haight Street....6

4 Before-and-After Travel Times - Haight Street....8

5 Traffic Signal Pre-emption Vehicle Detectors....12

6 Before-and-After Bus Stop Locations on Southbound Van Ness Avenue....14

7 Locating Bus Stops to Minimize Traffic Signal Delay....15

8 Removal of Stop Sign on Church Street at 26th Street....17

9 Bus Stop/Stop Sign Coordination....18

10 Farside Bus Stop at 4-Way Stop Intersection....19

11 O'Farrell Street Before Enforcement....22

12 O'Farrell Street After Enforcement....22

13 Stockton Street Before Enforcement....24

14 Stockton Street After Enforcement....24

15 Enforcement of Intersection Blockage Program....26

16 Third and Mission Streets Before Enforcement....28

17 Third and Mission Streets After Enforcement....28

18 Bus Loading Bulbs on Stockton Street....30

19 Stockton Street Bus Bulb Relocation Program....32

EXECUTIVE SUMMARY

The goal of the Transit Preferential Streets Program is to develop and implement measures which expedite the movement of transit vehicles on San Francisco streets. Accomplishments of this program over the last three years include:

- Design and implementation of bus stop reduction and relocation programs on Haight Street, Union Street, Van Ness Avenue, Polk Street, Mission Street, Third Street, and Sacramento Street-Columbus Avenue (41-UNION), resulting in improved transit travel time;

- Implementation of traffic signal pre-emption devices on Church Street, Irving Street and Haight Street, resulting in decreased signal delay for Muni vehicles;

- Performance of a series of before-and-after tests of the impact of parking and traffic enforcement on the flow of transit vehicles in downtown San Francisco, resulting in decreased traffic congestion and a better understanding of the role of enforcement in improving traffic flow;

- Development of an educational video, "The Benefits of Parking Enforcement," illustrating the findings of the enforcement tests;

- Removal of unwarranted stop signs on Church Street resulting in decreased delays for Muni vehicles;

- Relocation of numerous transit stops at stop-sign controlled intersections to prevent transit vehicles from having to stop twice at the same intersection, and development of a Board of Supervisors policy requiring that the installation of future stop signs be coordinated with transit stop planning;

- Evaluation of the transit lanes installed on Sutter, Post, Geary and O'Farrell Streets in 1982;

- Approvals for permanent installation of bus stop loading platforms on Stockton Street in Chinatown; and

- Approvals for restrictions of left turns from portions of Mission Street between 4-6 P.M. in order to decrease delays to transit.

This paper describes these projects and evaluates their impacts on improving transit service in San Francisco.

CHAPTER ONE

INTRODUCTION

The Transit Preferential Streets (TPS) program was established in 1973 by Board of Supervisors Resolution 189-73. The purpose of the program, according to that Resolution, is to expedite transit services, as "Increased speed and regular frequency of transit service serves to encourage greater use of public transit, which in turn reduces traffic congestion and air pollution and may well increase farebox revenues." The resolution also directs the Department of City Planning, in cooperation with other city departments, to develop a transit preferential streets plan to be reviewed by the City Planning Commission and recommended to the Board of Supervisors.

The UMTA Grant

In 1985, the City began work on a grant from the Urban Mass Transportation Administration to develop and implement transit preferential treatments on eight important San Francisco transit streets: Van Ness Avenue, Mission Street, Third Street, Polk Street, Union Street, Haight Street, Ocean Avenue, and Church Street. Additionally, the grant called for a specially designed program to test the relationship between parking enforcement and transit performance in San Francisco. A final requirement of the grant was the evaluation and permanent installation of the 1982 transit preferential improvements on Stockton Street and Sutter-Post-Geary-O'Farrell Streets east of Taylor Street. This report describes and evaluates the specific projects implemented in San Francisco under this grant-funded program. The location of TPS projects implemented during this period are shown on Figure 1.

TPS Program History

In compliance with Board of Supervisors Resolution 189-73, a document entitled "Transit Preferential Streets Program, a joint report by Public Works, Municipal Railway and City Planning," was produced in 1973. This report presented a selection of possible street improvements on ten important transit streets for the consideration of the City Planning Commission and the Board of Supervisors. The streets selected for initial study were Sutter and Post Streets, Geary and O"Farrell Streets, Mission Street, Stockton Street, Polk Street, Third and Fourth Streets and Fillmore Street. In addition to proposing special street treatments such as exclusive transit lanes and bus loading zone platforms or bus "bulbs," the 1973 report also suggested numerous administrative and enforcement actions which would expedite transit movement. Administrative actions discussed include traffic signal timing improvements, tow-away lane extensions, relocation of mail box and newspaper rack obstructions and discouragement of auto-oriented land uses on transit streets.

The 1977 "Report on the Status of the Transit Preferential Streets Program" provides a summary of the accomplishments of the program between 1973 and 1977. This document describes the implementation of transit lanes on the wider sections of Sutter and Post and Geary and O'Farrell Streets west of Taylor Street in 1974-77 as well as the construction of bus bulbs on Polk Street in May, 1974. Evaluation of these projects indicate that while the measures were appreciated by many Muni riders and operators, they had little measurable impact on transit speeds. Other proposals, such as a plan to

Figure 1

TPS PROJECT LOCATIONS

- BUS STOP RELOCATION PROGRAMS
- SIGNAL PRE-EMPTION INSTALLATIONS
- STOP SIGN REMOVALS
- BUS BULB LEGISLATION
- TRANSIT LANE EVALUATION
- ENFORCEMENT STUDY LOCATION
- LEFT TURN PROHIBITIONS

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divert much of the auto traffic on Mission Street between Fourth and Eleventh Streets, were met with public protest and were never implemented. Finally, two general problems facing the TPS program are described: the lack of enforcement of traffic restrictions on transit streets, and the lack of support for those transit preferential measures which interfere with auto traffic.

In the early 1980s, several notable transit preferential projects were implemented: all-day transit lanes were provided on the narrower sections of Sutter, Post, Geary and O'Farrell Streets east of Taylor Street, bus bulbs were constructed on Stockton Street in Chinatown and a bus lane on Stockton Street south of the tunnel was installed. The momentum provided by these projects led to the application for the UMTA grant summarized in this report.

The TPS Committee

Because transit preferential projects often cut across the jurisdiction of several city departments, the Transit Preferential Streets Committee was formed to coordinate such efforts between the staffs of the affected city departments. The TPS committee consists of representatives of the Municipal Railway (Muni), which is responsible for transit operations; the Department of Public Works, which is responsible for traffic engineering operations; the Police Department, which is responsible for traffic and parking enforcement; and the Department of City Planning, which is responsible for the city's Master Plan and Transit Preferential Streets Program. The TPS committee meets on an as-needed basis.

Methodology

A key element of the TPS program's strategy in recent years has been the quantification of different types of transit delays, along with the evaluation of the impact that implemented programs have on reducing these problems. Transit "speed-and-delay" studies are used to quantify the cause and duration of delays encountered by transit vehicles, such as traffic signals, passenger loading, double-parking or general traffic congestion. With this information, the committee is able to identify the major sources of time loss on each transit line and concentrate its efforts on removing the sources of these delays. The committee is thus able to direct its efforts to projects that will have the greatest benefit for Muni, rather than devoting time and energy to developing solutions to problems that have only a perceived impact on Muni travel times. In several cases, this process has resulted in some surprising findings, indicating that the causes of transit delay are not always obvious or intuitive.

By performing before-and-after evaluations of TPS projects, the committee is also able to determine which strategies are most effective in obtaining the desired reductions in travel time. This data is not only useful in determining which strategies might be effective at other locations, but can also be helpful in earning public support for similar projects.

Overview of Transit Delays in San Francisco

Figure 2 summarizes some typical transit "speed-and-delay" data developed by the TPS program on various San Francisco streets. The figure indicates that

while delays caused by traffic signals and traffic congestion are significant, the factor which slows transit vehicles the most is the time required for passengers to get on and off the vehicles. This finding suggests that any measures which can improve the efficiency of the passenger boarding function on Muni could have a substantial impact on improving transit speeds.

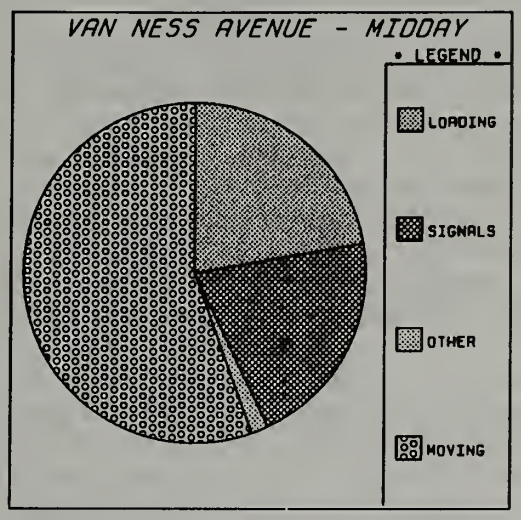
The second largest factor contributing to transit slowdowns is traffic signal delay. This category includes the time the vehicle spends standing at red lights, and the time required for traffic to begin moving after the signal turns green. The "other" delay category includes delays generally associated with traffic congestion: double-parking delays, delays caused by vehicles waiting to make a left or right turn, general back-ups in traffic and delays encountered by buses in pulling into or out of a bus stop. Also included in this category are delays to buses caused by other buses. Examples of this type of delay include buses waiting to enter a bus stop until the bus ahead has vacated the stop, or trolley buses waiting for preceeding trolleys to move because of their inability to pass one another.

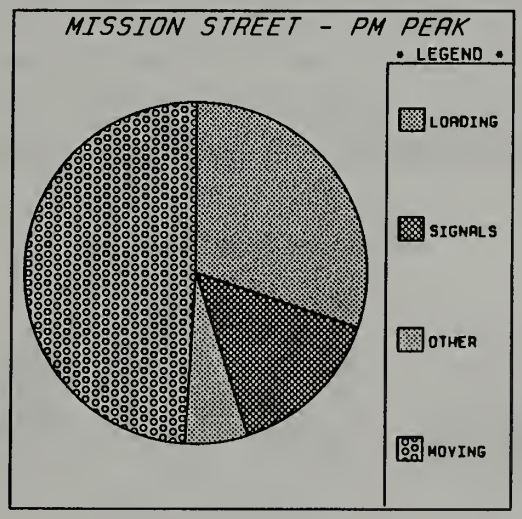
Organization of This Report

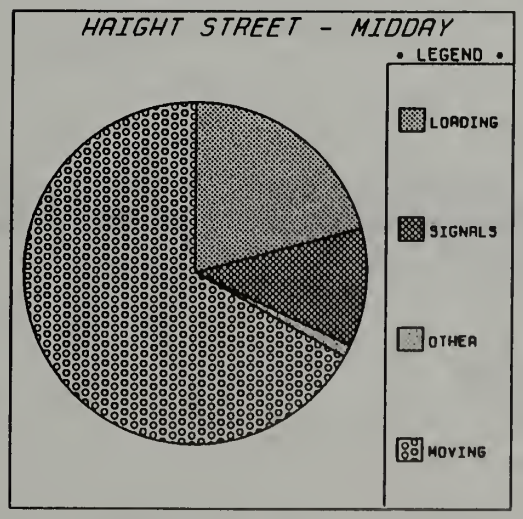
The remainder of this report describes and evaluates the specific accomplishments of the TPS program between 1985 and 1988. Bus stop reduction projects implemented by the TPS Program on several streets are discussed in Chapter Two. Chapter Three presents a summary of the projects designed to decrease delays to Muni vehicles caused by traffic control devices (traffic signals and stop signs). Projects designed to decrease delays through improved parking enforcement are discussed in Chapter Four. Chapter Five describes additional accomplishments including the evaluation of 1982 transit preferential measures on Sutter, Post, Geary and O'Farrell Streets; approvals for left turn restrictions on portions of Mission Street and approvals for permanent bus bulbs on Stockton Street. Conclusions of this report are summarized in Chapter Six.

FIGURE 2

TYPICAL MUNI SPEED AND DELAY PROFILES







CHAPTER TWO

REDUCING TRANSIT DELAYS THROUGH BUS STOP REDUCTIONS

The average speed that buses and streetcars are able to achieve is closely related to the distance between stops made by the vehicle. The longer the distance between stops, the higher the average speed the vehicle is able to attain. Increasing the distance between passenger stops, therefore, can be an effective and low-cost method of improving transit performance. Muni policies for bus stop spacing call for locating bus stops approximately 1,000 feet apart except where grades exceed 10 percent or transfers are made to intersecting routes. However, many bus stops in San Francisco are actually located much closer than this. The TPS program has sought to improve Muni performance on seven important transit streets in San Francisco by bringing bus stop spacing into conformance with this standard.

Before-and-after results of seven bus stop reduction and relocation projects performed by the Transit Preferential Streets program are described in this section. Statistically significant increases in average bus travel speeds were found, without any adverse affects on patronage, as a result of improved bus stop spacing. The change in stop locations made in this program generally means that bus stops are located on every second corner of east-west streets in San Francisco, rather than on every corner. Before-and-after bus stop locations for a typical program are shown on Figure 3.

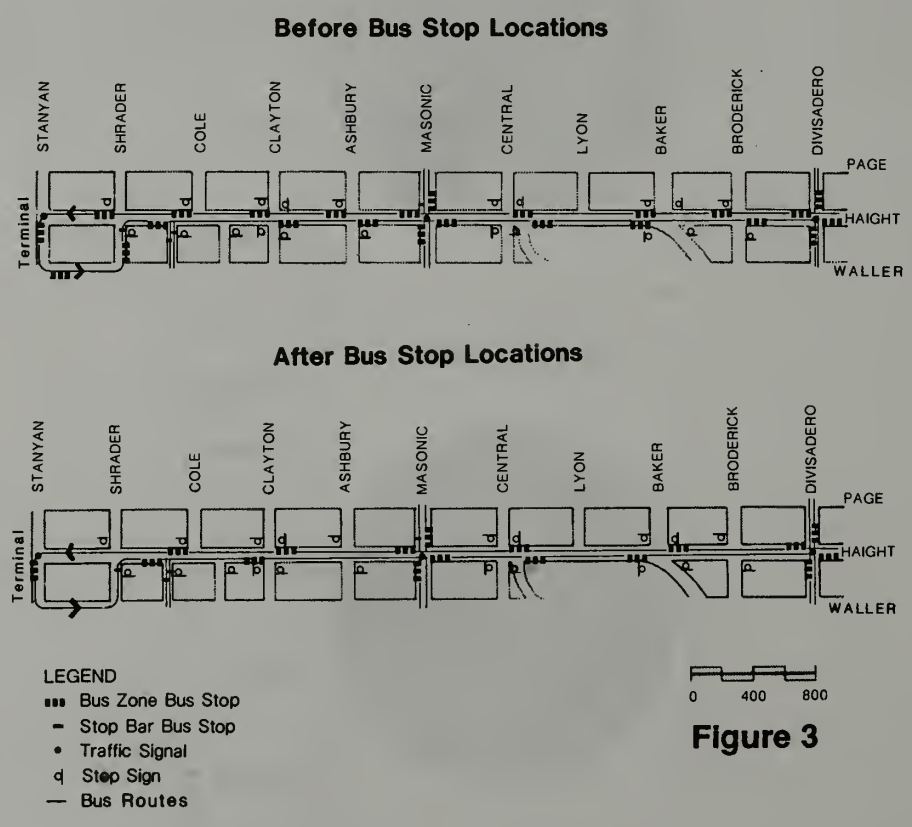


Figure 3

The bus stop reduction projects were conducted on seven Municipal Railway transit corridors: Haight Street, Union Street, Van Ness Avenue, Polk Street, Mission Street and Third Street and the Sacramento Street-Columbus Avenue portion of the 41-UNION route. The projects performed by the TPS program sought to bring these routes into conformance with Muni's 1,000 foot spacing spacing policy. A description of bus stop removal criteria, data collection procedures, evaluation findings, parking impacts, citizen participation and public reaction to the program is presented below.

Bus Stop Removal Criteria

Factors considered in locating bus stops included:

- Number of boarding and alighting passengers at each stop;
- Spacing between stops;
- Transfers between intersecting lines;
- Grades;
- Traffic control devices (signals and stop signs);
- Adjacent land uses;
- Location of facilities serving concentrations of elderly and handicapped riders; and
- Opportunities to create additional legal curb parking spaces.

Several bus stops located on the far side of of four-way stop sign controlled intersections were relocated to the near side of the intersection so that buses would not have to stop on each side of the intersection. Other stops were relocated in order to take advantage of existing traffic signal timings. (These aspects of the changes are discussed in more detail in Chapter Three).

Data Collection

Transit travel time data were collected by Muni field personnel stationed at each end of the route segment. The field crews recorded the number of each bus and the exact time that it passed each observation point. This method allows for the collection of a large enough sample of bus runs (30-100 vehicles in each direction over a six hour observation period) to determine whether the changes in bus travel time were statistically significant. Sample sizes smaller than this used in earlier evaluation efforts led to inconclusive findings, as the travel time of individual buses varies too much for small samples of data to be meaningful.

Findings

Results of the before-and-after travel time studies are shown on Table 1. Increases in average bus speeds were found on all streets where substantial reductions in the number of bus stops were made. Improvements were most dramatic on Haight, Union and Mission Streets, and somewhat smaller on Polk, Van Ness and on Sacramento-Columbus.

Table 1

Before-and After Results of Bus Stop Reduction Programs

STREET	BEFORE Stops Per Mile	BEFORE Average Bus Speed	AFTER Stops Per Mile	AFTER Average Bus Speed	CHANGE Average Bus Speed
Haight Street	10.7	8.2 mph	7.1	9.4 mph	+14.6%
Union Street	11.0	9.1 mph	7.1	10.0 mph	+9.9%
Van Ness Avenue	10.6	6.2 mph	8.2	6.5 mph	+4.8%
Polk Street (NB Direction Only)	12.0	9.1 mph	7.8	9.5 mph	+4.4%
Mission Street (NB Direction Only)	10.4	6.1 mph	5.2	6.8 mph	+11.5%
Sacramento-Columbus (NB Direction only)	13.2	5.4 mph	7.3	5.8 mph	+7.4%

Data for Third Street not available.

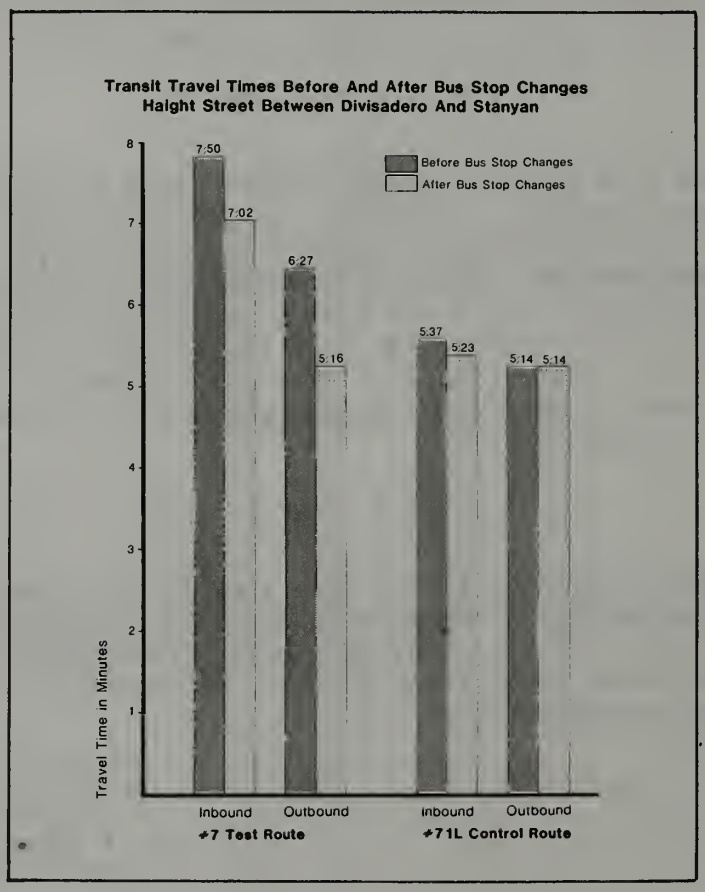


Figure 4

Discussion

Travel time improvements measured on the six streets shown on Table 1 were significant at the 0.05 level. Improvements did not appear to be due to other factors such as traffic volume variations or changes in ridership. On the Haight Street project, travel times on the 71L-HAIGHT-NORIEGA served as a "control" for the study, as this limited-stop route operated on the same street but was not affected by the bus stop changes. Travel times on the 71L did not change between the "before" and "after" periods, indicating that traffic and weather conditions were not responsible for the improved "after" travel times on the 7-HAIGHT route (see Figure 4). Before-and-after patronage counts made as part of the Van Ness Avenue and the 41-Union routes did not indicate significant changes in ridership between the "before" and "after" periods, except for an increase on the 41 line, which may explain why its travel time did not increase as much as on some other routes.

The reduction in the number of bus stops increased the walking distance to and from bus stops for some Muni passengers. In most cases, the maximum increase in walking distance experienced along a route was between 480 and 580 feet, the length of most San Francisco blocks. The reduction in bus stops also decreased undesireable noise and air impacts of accelerating diesel buses, and increased the on-street parking supply in many neighborhood commercial and residential areas, as described below.

On-Street Parking Supply Impacts

Removed curb transit stops were typically replaced with metered parking spaces in commercial areas and with additional neighborhood parking spaces in residential areas. This was generally viewed as a positive impact by local merchants and residents, as on-street parking space is in short supply in many parts of San Francisco. In some cases, the removal and relocation of bus stops was combined with reductions in the length of red zones at fire hydrants in compliance with recently revised standards developed by the San Francisco Fire Department. In metered areas, the removal and relocation of bus stops were combined with an on-going effort by the Department of Public Works to decrease the length of metered parking spaces from 22 to 20 feet in response to decreasing car sizes. These changes allowed further increases in the number of on-street parking spaces. Table 2 indicates the number of legal parking spaces gained solely as a result of the bus stop reduction programs.

Table 2

Parking Spaces Gained Through Bus Stop Reductions

LOCATION	LEGAL SPACES GAINED
Haight Street	16
Outer Mission Street	17
Polk Street	19
Third Street	8
Van Ness Avenue	23
Union Street	34
Sacramento-Columbus (41-UNION)	7
TOTAL	123

Citizen Participation

Transit stop relocation plans were developed with a significant amount of input from the community. Merchants along transit routes which were considered for relocation programs were visited in the field and consulted regarding their preferences for transit stop locations. All transit stop changes went through formal public hearings conducted by the Department of Public Works. Announcements of public hearings regarding bus stop changes were distributed to area merchants and neighborhood groups and posted on utility poles in the affected areas. Bus stop relocation proposals were often refined in response to public comments received at these hearings.

In many cases, proposals to relocate curb transit stops provided an opportunity for neighborhood merchants to suggest other changes to curb parking restrictions. The TPS program incorporated many of these requests into the bus stop relocation plans so that all curb marking changes for a given street could be heard at the same public hearing and implemented at the same time.

Public Reaction

Merchant reaction to the bus stop reduction and relocation projects was generally favorable, primarily because the projects increased the on-street parking supply in the general area. Merchant groups, in fact, were effective advocates of several of the projects during the public review periods. Nevertheless, some merchants who felt that they would be negatively impacted by either the removal or the installation of a bus stop in front of their business did object at public hearings.

Rider reaction was somewhat mixed: several written complaints were received from elderly riders who objected to walking an additional block, particularly where the street was not flat. On the other hand, some riders wrote letters praising the faster and smoother ride made possible by the reduction in stops.

Conclusions

Increasing the spacing between transit stops can be an effective measure in improving the productivity of transit routes, and can provide riders with a faster, more comfortable ride, although walking distances to and from stops are increased for some riders. Additional benefits can include decreased noise and air pollution and additional on-street parking availability. It is recommended that similar bus stop relocation and reduction projects be performed on other Muni routes where stop spacing does not conform to Muni policy. Candidate streets include:

Chestnut Street;
Eddy Street;
McAllister Street;
Hayes Street;
Clement Street;
Divisadero Street;
18th Street; and
Potrero Avenue.

CHAPTER THREE

REDUCING DELAYS CAUSED BY TRAFFIC CONTROL DEVICES

Efforts to decrease delays to transit caused by traffic control devices (traffic signals and stop signs) are summarized in this section. Specific projects which are described below include traffic signal pre-emption projects, removal of unwarranted stop signs along transit routes, coordination of bus stops with traffic signal timings and coordination of bus stops with stop signs.

Traffic Signal Pre-Emption

Traffic signal pre-emption devices allow traffic signals to detect the presence of approaching transit vehicles and give them a green light. In order to test the effectiveness of this technology in San Francisco, traffic signal pre-emption devices were installed at four signalized intersections in 1988:

Church and 15th Streets (J-CHURCH Metro, 22-FILLMORE Trolley Coach);
Church and 17th Streets (J-CHURCH Metro);
Irving Street/6th Avenue (N-JUDAH Metro); and
Haight Street/Masonic Avenue (6-PARNASSUS Trolley Coach, 7-HAIGHT Trolley Coach).

These signalized intersections were selected for the following reasons:

- Transit vehicles experience considerable delays there;
- Most of the transit vehicles at these intersections are electrically powered, allowing for vehicle detection through the overhead power lines;
- Interruption of the normal signal timings at these locations would not create serious delays for traffic on the cross streets; and
- There are no passenger boarding stops or traffic signals between the point where the vehicle is detected and the traffic signal which is pre-empted. The absence of stops between these two points makes the arrival time of the transit vehicle at the traffic signal more predictable, thereby maximizing the vehicle's chances of arriving at the signal during the green signal phase created for it.

How They Work - Muni vehicles approaching the pre-emption equipped intersections are detected by a device attached to overhead power lines several hundred feet upstream of the intersection, as shown on Figure 5. This device signals the traffic signal controller that a Muni vehicle is approaching the intersection. If the signal is green for transit vehicles at the time of detection, the controller will hold the green signal phase long enough for the Muni vehicle to clear the intersection. If the signal has just turned green for the cross street (and red for the transit street), the controller will provide the cross street with the minimum amount of green time necessary for a pedestrian to cross the transit street before providing a green signal to the transit street.

Figure 5

Detectors placed on overhead trolley and streetcar lines notify traffic signal of approaching transit vehicle.

Impact on Muni Service - The impacts of the pre-emption devices on Muni service were quantified by before-and-after measurements of the percentage of transit vehicles caught by a red light at each intersection and the average amount of time each vehicle was delayed by the signal. Before-and-after results are shown on Table 3. The percentage of Muni vehicles which were delayed at each pre-empted intersection declined by between 73 and 90 percent. The average time that each vehicle was delayed declined from between 7.7 and 11.5 seconds "before" the pre-emptions to between 0.6 and 1.8 seconds "after" pre-emption.

Impact on General Traffic Delays - The impact of the pre-emptions on general traffic delay at the pre-empted intersections was evaluated through observations of the number of non-transit vehicles delayed by red lights on each intersection approach both before and after the pre-empts were installed. No significant increases in the percentage of traffic that was delayed by traffic signals was found at either of the three intersections evaluated to date.

Costs and Benefits - If it is assumed that the average time saved at each pre-emption averages 10 seconds and that Muni operating costs are $60 per hour, the pre-emptions would result in an annual operating cost savings of $27,840 at Church and 15th Streets and $12,960 at Church and 17th Streets. With these cost savings, the estimated $10,000 capital cost of the pre-emption devices would be recovered in less than one year. It should be noted, however, that the time savings achieved may not be directly convertible into true operating cost savings unless they are substantial enough to reduce the number of transit vehicles required to operate service on the line. The impacts of the pre-emptions on Muni riders are more difficult to quantify, but could very likely result in improved ridership due to travel time reductions and improved rider comfort.

Table 3

Before-and-After Impacts of Traffic Signal Pre-Emption

	BEFORE		AFTER		CHANGE	
INTERSECTION	Percent Delayed	Average Delay	Percent Delayed	Average Delay	Percent Delayed	Average Delay
Church/15th	55	9.9 sec.	15	0.6 sec.	-73%	-9.3 sec.
Church/17th	58	11.5 sec.	6	1.0 sec.	-90%	-10.5 sec.
Irving/6th Av.	55	7.7 sec.	9	1.8 sec.	-84%	-5.9 sec.

Data for Haight/Masonic installation not available.

Conclusions Regarding Signal Pre-Emption - The results of the pre-empt tests on Church and Irving Streets indicate that the pre-empts are effective in reducing transit delays and do not have a detrimental impact on general traffic flow at these locations. These conclusions, however, are not necessarily transferable to other intersections that do not experience the same magnitude of signal delay for transit vehicles or to locations where transit vehicles must stop at the intersection to board passengers. Pre-emption may be more disruptive to general traffic flow at locations where existing signal timings provide better signal progression for cross traffic.

It is recommended that additional pre-emptions be installed along Muni trolley and streetcar routes where they will decrease Muni delays without presenting safety problems on cross streets. Candidate signalized intersections include Sacramento/Gough (1-California), Union/Fillmore (41-Union), Mission/Bosworth (14-Mission), Mission/17th Street (14-Mission 49-Ocean) and Sutter/Webster (3-Jackson, 4-Sutter). Additionally, new traffic signals equipped with pre-emptive devices could be installed at intersections which are currently controlled by stop signs. Candidate intersections for this treatment include West Portal/Vicente and West Portal/15th Avenue (K-Ingleside, M-Oceanview) and Duboce/Sanchez (N-Judah).

Coordination of Transit Stops With Traffic Signal Timings

Traffic signals on many San Francisco streets are synchronized, allowing a "progression" of green lights for traffic which is moving at the normal speed. However, because transit vehicles must make frequent stops to board and unload passengers between signals, they travel at a speed considerably slower than normal traffic. Therefore, signal timing schemes which may be advantageous to general traffic can be disadvantageous to transit vehicles. The TPS committee found that in some cases, these signal timing conflicts could be corrected by changing the location of bus stops relative to traffic signals. An example of a location where this strategy was found to be successful in reducing signal delay for transit vehicles is presented below.

Van Ness Avenue Signal Timings - The example takes place on Van Ness Avenue, a heavily travelled two-way street with closely spaced traffic signals and three major bus routes. Before-and-after bus stop locations for the southbound segment of the street discussed are shown on Figure 6. Signal timings through this street segment are represented by the time-space diagrams shown on Figure 7. The signal timing scheme is a "triple alternate," in which signals simultaneously turn from green to red in sets of three. This means that while the first three signals on the street are turning from green to red, the next three signals are simultaneously turning from red to green. This timing scheme provides a narrow band of green signals for both southbound and northbound traffic travelling at a speed of about 25 MPH.

BEFORE AND AFTER BUS STOP LOCATIONS ON SOUTHBOUND VAN NESS AVENUE

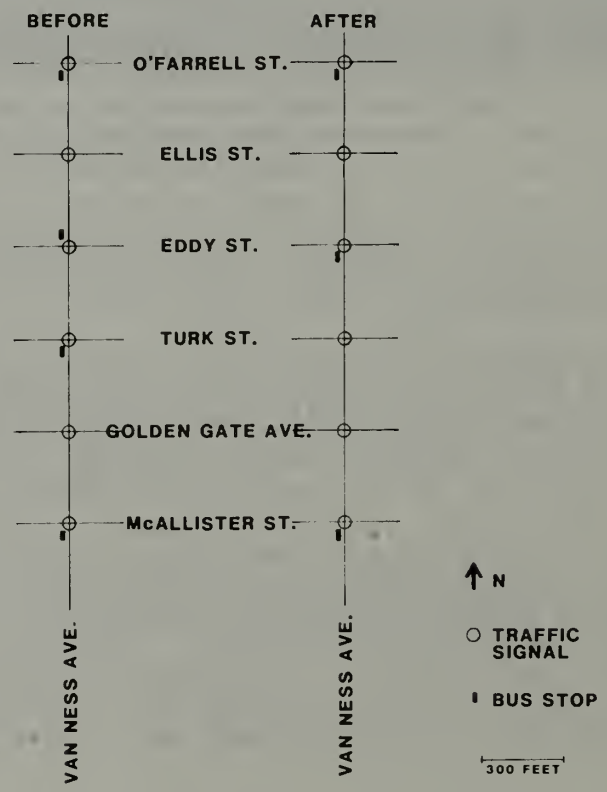


Figure 6

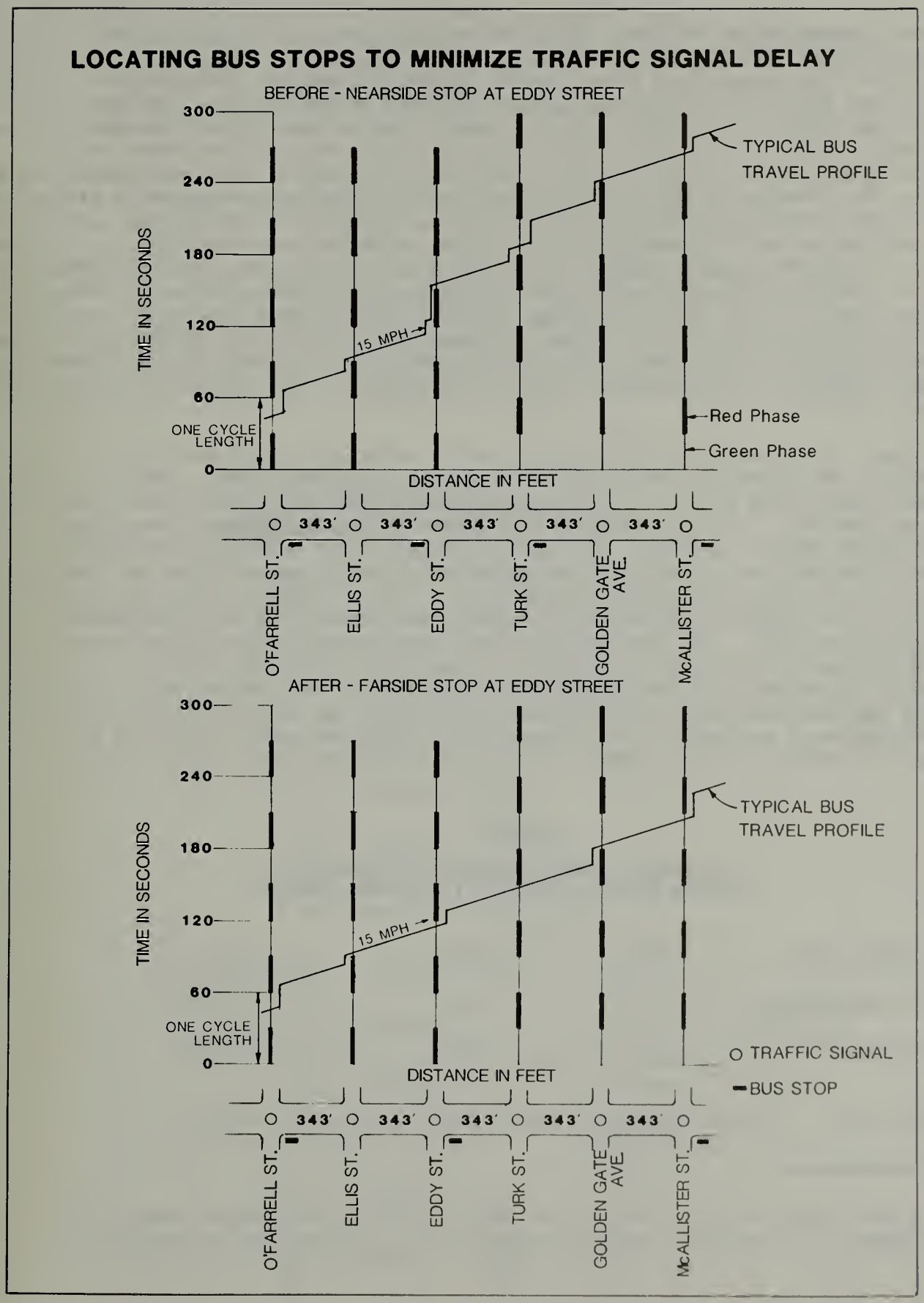

LOCATING BUS STOPS TO MINIMIZE TRAFFIC SIGNAL DELAY
BEFORE - NEARSIDE STOP AT EDDY STREET
TIME IN SECONDS
300
240
180
120
60
0
ONE CYCLE LENGTH
15 MPH
TYPICAL BUS TRAVEL PROFILE
Red Phase
Green Phase
DISTANCE IN FEET
343'
O'FARRELL ST.
ELLIS ST.
EDDY ST.
TURK ST.
GOLDEN GATE AVE.
McALLISTER ST.
AFTER - FARSIDE STOP AT EDDY STREET
TIME IN SECONDS
300
240
180
120
60
0
ONE CYCLE LENGTH
15 MPH
TYPICAL BUS TRAVEL PROFILE
TRAFFIC SIGNAL
BUS STOP
DISTANCE IN FEET
343'
O'FARRELL ST.
ELLIS ST.
EDDY ST.
TURK ST.
GOLDEN GATE AVE
McALLISTER ST.

Figure 7

"Before" Signal Delay Problem - The time-space diagram also indicates the location of bus stops on Van Ness Avenue and the movement of a typical southbound bus through this area. In the "before" situation, there was a "near side" bus stop on Van Ness Avenue just north of Eddy Street. (A "Near side" stop means the bus stops before it enters the intersection.) Because the signals at Ellis and Eddy Streets operate simultaneously, southbound buses typically arrived at the Eddy Street signal near the end of the green phase for Van Ness Avenue. However, this signal typically turned from green to red during the time the bus was loading passengers at the near side bus stop. The bus thus had to wait through the red signal phase before entering Eddy Street. Once the signal at Eddy Street turned green so the bus could proceed, the next downstream traffic signal (at Turk Street) made the alternate signal change (from green to red), resulting in another signal delay for the southbound bus at Turk Street. Thus, the near side bus stop on Van Ness Avenue at Eddy Street not only caused most buses to wait through the red phase at Eddy Street, it also caused most buses to receive a red light at Turk Street as well.

Solution - The solution to this problem was to relocate the Van Ness/Eddy Street bus stop from the near side to the far side of Eddy Street. This change allows buses which arrive at Eddy Street on the green signal phase, as most of them do, to take advantage of the green light and proceed through the intersection before stopping. As shown on Table 4, this relocation resulted in an 82 percent reduction in the number of buses getting a red light at Eddy Street. The general principle followed here is that if the bus tends to arrive at the intersection during the green signal phase, the bus stop should be located far side. The new stop location also changed the arrival patterns of southbound buses at the Turk Street intersection. Prior to the stop changes, the majority (60 percent) of southbound buses arrived at Turk Street during the red signal phase. After the stop change, the majority of the southbound buses arrived at Turk Street during the green phase, resulting in a 38 percent decrease in the number of buses getting a red light at this signal.

Table 4

Percentage of Buses Delayed by Traffic Signal
Van Ness Avenue at Eddy and Turk Streets - Midday

INTERSECTION	BEFORE	AFTER	CHANGE
Van Ness/Eddy	57%	10%	-82%
Van Ness/Turk	60%	37%	-38%

Sample sizes: 51 buses in before sample, 42 buses in after sample.

Stop Sign Removals

Stop signs along transit routes can be very detrimental to transit speeds and performance, forcing every vehicle to stop at the intersection on every trip, whether or not there is any other vehicular or pedestrian traffic present.

Once installed, stop signs are very difficult to remove because nearby residents usually support them at public hearings and drivers and pedestrians become accustomed to their presence and may not notice that they have been removed. Nevertheless, the TPS program was successful in converting one four-way stop-sign controlled intersection to a two-way stop, eliminating the need for Muni vehicles to stop at this intersection.

The stop signs that were removed were on Church Street at 26th Street, on a residential section of the J-CHURCH Metro line (see Figure 8). The intersection was one of four consecutive four-way stop-sign controlled intersections on Church Street within a span of only 1200 feet. Muni boarding stops which had been located at 26th Street were relocated to Army Street so that the Muni vehicles would not have to stop at 26th Street at all once the traffic stop signs were removed. As shown on Table 5, removal of the traffic stop signs on Church Street at 26th Street were shown to decrease the average round trip transit travel time on Church Street between 25th and 28th Street by 25 seconds, increasing the average transit speed from 8.8 MPH to 9.8 MPH.

REMOVAL OF STOP SIGN ON CHURCH STREET AT 26TH STREET

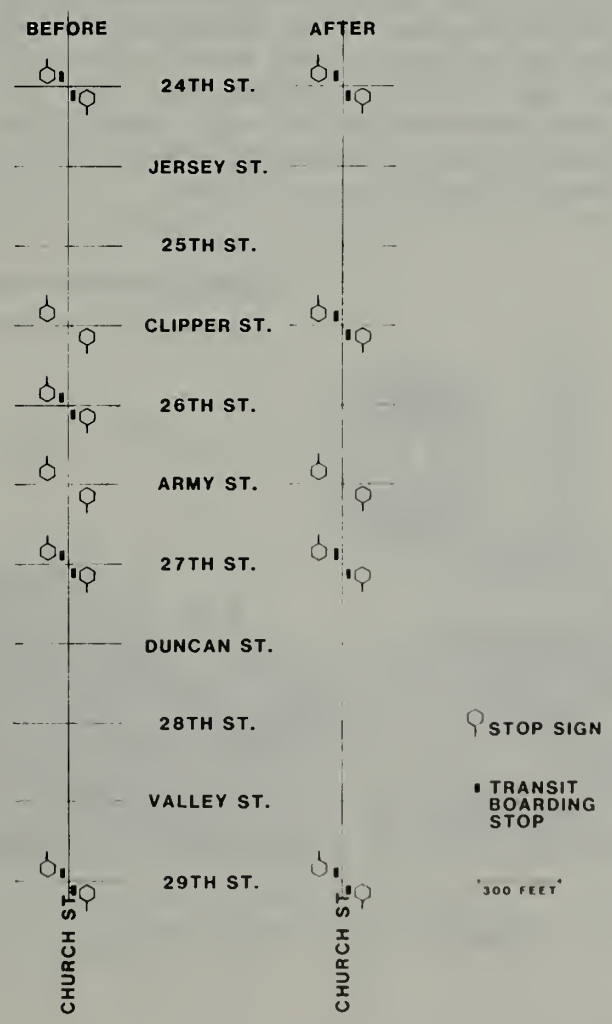


Figure 8

Table 5

Streetcar Travel Times Before-and-After Stop Sign Removal
Church Street Between 25th and Duncan Streets

	BEFORE	AFTER	DIFFERENCE
Northbound			
Average Travel Time	116.6 Seconds	108.5 Seconds	-8.1 Seconds*
Average Speed Through Study Area	8.8 MPH	9.4 MPH	+0.6 MPH
Southbound			
Average Travel Time	116.5 Seconds	99.8 Seconds	-16.7 Seconds
Average Speed Through Study Area	8.8 MPH	10.2 MPH	+1.4 MPH

Sample size: 37+ cars per direction.

Coordination of Transit Stops and Stop Signs

Lack of coordination between stop sign and bus stop planning in San Francisco has resulted in the awkward situation where many transit vehicles must "double stop" at stop-sign controlled intersections. This occurs when transit vehicles must stop at the "near side" of the intersection (before entering the intersection) for a stop sign, and again on the "far side" of the intersection (after passing through the intersection) for a bus stop. (See Figure 9.) These "double-stops" result in slow transit service and a jerky and uncomfortable ride for transit patrons.

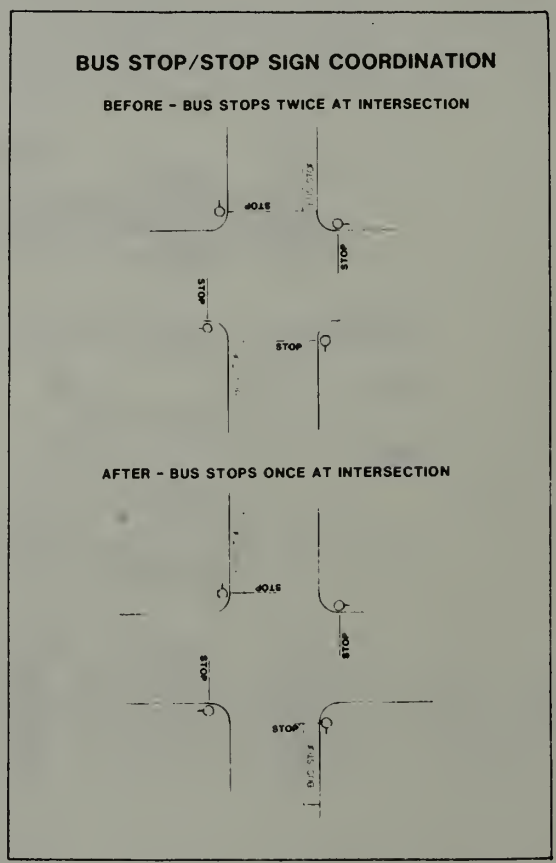


Figure 9

Most bus stop changes in San Francisco originate with Muni and are reviewed at public hearings conducted by the Department of Public Works, which is responsible for on-street parking regulations. Traffic stop signs, on the other hand, must be approved by the Board of Supervisors. In many cases, the Board has approved stop signs at intersections with far side bus stops without any action being taken by Muni to relocate the bus stops until several months or years later. Attempts to relocate the bus stops at a later date are frequently met with resistance by adjacent property owners or merchants who see no relationship between the bus stop locations and the now-familiar traffic stop signs.

The TPS program has relocated many of these bus stops to the near side in order to reduce transit delays as part of the bus stop relocation program described in Chapter Two. Additionally, the TPS program sponsored a new city policy which requires that bus stop locations be considered in the decision to install new stop signs. An analysis of the impact of relocating bus stops to the near side of stop-sign-controlled intersections is presented below, along with a description of the policy created to discourage this situation from arising in other locations.

Impacts of Relocating Bus Stops to Nearside - Figure 10 shows the intersection of Polk and Vallejo Streets, a typical four-way stop-sign controlled intersection where far side bus stops were relocated to the near side of the intersection. Travel times of buses passing through this intersection were recorded both before and after the bus stops were relocated to the near side of the intersection. Results of this data, shown on Table 6, indicate that buses save an average of four seconds in travel time by having the bus stop located at the near side of stop sign-controlled intersections compared to the far side of these intersections. Additionally, the relocation of the bus stops resulted in a decrease in noise created by accellerating diesel buses and in a smoother ride for Muni passengers due to less frequent stops.

Prior to relocation of bus stop to nearside, farside stop at stop sign - controlled intersection forced buses to stop on either side at intersection.

Figure 10

Table 6

Reduction In Bus Travel Time Due to Coordination of Bus Stops and Stop Signs Polk/Vallejo Intersection

	BEFORE (Far Side Bus Stops)	AFTER (Near Side Bus Stops)	DIFFERENCE
Average Travel Time	28.9 Seconds	24.7 Seconds	-4.2 Seconds
Average Running Speed*	8.1 MPH	9.4 MPH	+ 1.3 MPH

Sample size: 32 buses
*Between one-half block south of Vallejo Street and one-half block north of Vallejo Street. Excludes boarding time.

Policy to Encourage Coordination - In order to prevent the "double-stop" situation from arising at other San Francisco intersections, the TPS Committee drafted a policy designed to encourage the coordination of bus stop and stop sign planning. The policy was adopted by the Board of Supervisors and signed by the Mayor as Resolution 410-86 in June, 1986. The Resolution states that if the Board of Supervisors is considering the installation of a traffic stop sign at an intersection that has far side bus stops, it must first request that the Department of Public Works hold a public hearing on the relocation of the bus stops to the near side of the intersection. While the Board may still approve the installations of stop signs even if the relocation of the bus stops is not approved by the Department of Public Works, this process compels the decision makers and the community to recognize the relationship between the two matters.

Conclusions

Delays to transit caused by traffic control devices can be substantially reduced in a variety of ways. Along trolley bus and streetcar routes, traffic signals can be pre-empted through the installation of special equipment on the overhead lines. Through traffic signal systems, signal delay can be reduced somewhat through coordination of bus stop locations with traffic signal timings. At stop-sign controlled intersections, delays can be reduced by the removal of unwarranted stop signs, and by locating bus stops at the near side of the intersection.

CHAPTER FOUR

IMPROVING TRANSIT SPEEDS THROUGH PARKING ENFORCEMENT

Several before-and-after tests of the impact of parking enforcement on transit speeds were conducted as part of the TPS program. In many cases, parking enforcement was found to be very effective in reducing traffic congestion and improving transit performance. To help demonstrate the dramatic results of these tests, a videotape presentation employing time-lapse photography was prepared as part of the TPS program. The videotape, entitled "The Benefits of Parking Enforcement," is available from the San Francisco Department of City Planning.

This Chapter summarizes the before-and-after analysis of the findings of the special projects designed to isolate the impacts of improved parking and traffic enforcement on transit performance. Projects discussed include a test of improved parking enforcement of a curb transit lane on O'Farrell Street in the downtown shopping area, a test of improved enforcement of the 30 minute time limit in truck loading zones on Stockton Street in the Chinatown area, and a test of the effectiveness of the DON'T BLOCK THE BOX project at the intersection of Third and Mission Streets in downtown San Francisco.

O'Farrell Street Transit Lane Enforcement

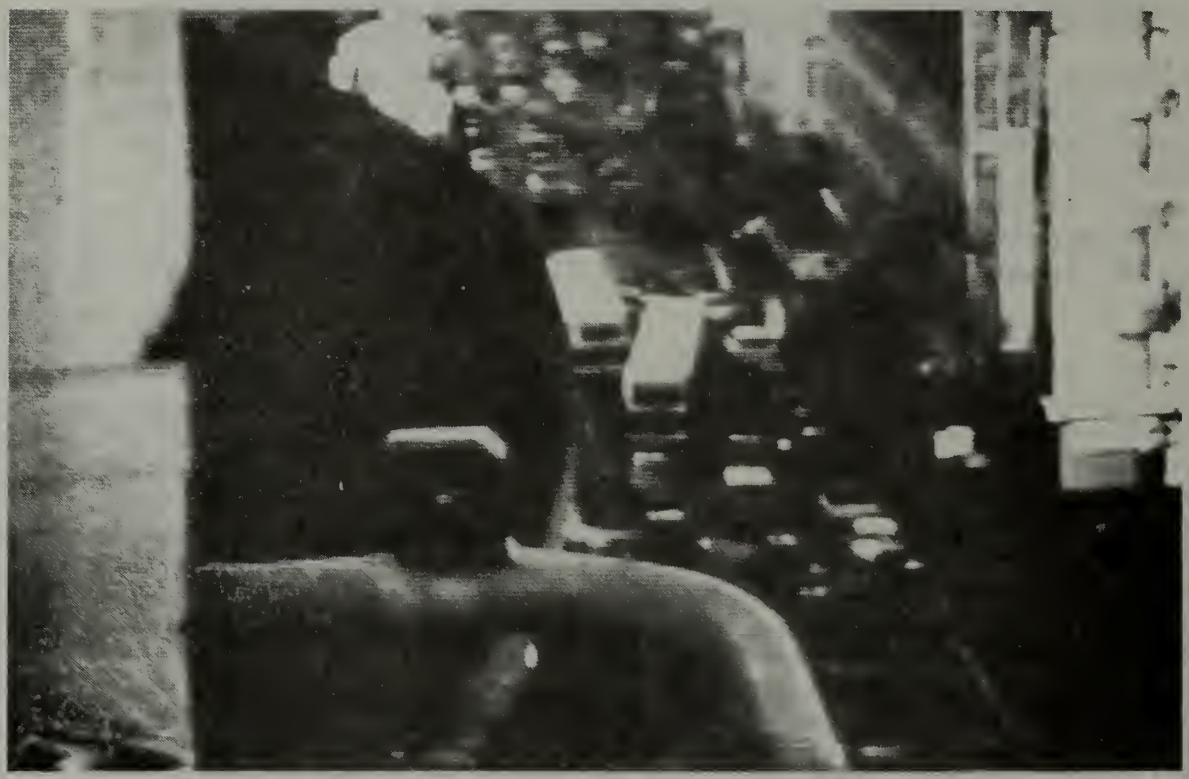
A test of the importance of parking and traffic enforcement on the effectiveness of transit lanes was performed on the two-block segment of O'Farrell Street between Mason and Stockton Streets on several Saturdays in February and March, 1986. An all-day curb transit lane was implemented on the south side of this street between Mason and Powell Streets as part of the 1982 transit improvement package. Parking was also restricted for the length of the south curb of the block between Powell and Stockton Streets to provide a bus stop and a right-turn-only-lane onto southbound Stockton Street. Parking was thus prohibited on the south curb for the entire two block study area.

The Problem - A lack of adequate police enforcement in this congested area had led to rampant abuse of these NO STOPPING AT ANY TIME restrictions, resulting in very heavy traffic congestion on O'Farrell Street for both buses and general traffic. Because the problem was particularly severe on Saturdays when police deployment was relatively light, despite heavy traffic and pedestrian activity, the TPS committee decided to focus on that day.

Methodology - "Before" transit travel time data was collected on several Saturdays prior to the increase in parking enforcement. Additionally, time-lapse photography was used to provide a visual record of the "before" conditions. One week prior to the step-up in enforcement, police personnel issued notices to all illegally parked cars and to nearby businesses and employers reminding them of the Saturday parking restrictions and warning them of the scheduled increase in ticketing and towing of illegally parked vehicles.

Impacts of Enforcement Program - Impacts of the enforcement test are pictured on Figures 11 and 12 and summarized in Table 7. The increase in enforcement resulted in a tremendous reduction in congestion on O'Farrell Street. The street was effectively "widened" from two moving lanes to three, and buses and right-turning traffic were able to use the curb lane which had previously been

(Reproduction from videotape)



O'Farrell Street Before Enforcement.

Figure 11

O'Farrell Street After Enforcement.

Figure 12

used only for illegal parking. Average transit travel times for the 700 foot-long study area decreased from three minutes, 25 seconds "before" to two minutes, 17 seconds "after." Although travel time data was not recorded for other traffic, congestion for automobiles appeared to be reduced signficantly based on the time-lapse photography and on the reduction in the length of the back-up of traffic on O'Farrell Street west of Powell Street from five to six blocks "before" to one or two blocks "after."

Table 7

Impacts of Increased Enforcement
O'Farrell Street

MEASURE	BEFORE	AFTER
Average Bus Travel Time	3:25	2:17
Standard Deviation	1:08	0:21
Sample Size	25	32
Average Speed	3.2 mph	4.8 mph

Stockton Street Truck Loading Zone Enforcement Test

A test of the impact of improved parking enforcement in reducing double-parking was conducted on Stockton Street in Chinatown in October, 1986. This test focused on the enforcement of the 30 minute time-limit restrictions on truck loading zones in this very active commercial area.

The Problem - The section of Stockton Street studied is made up primarily of meat and fish markets with very heavy truck loading activity. In order to accommodate as many trucks as possible at the curb, the entire curb parking lane is designated as a "Special Truck Loading Zone," restricted to trucks-only with a maximum stay of 30 minutes. Due to a lack of enforcement of this 30 minute time-limit restriction, many trucks remained parked in the truck loading zones for the entire day. This behavior forced trucks with legitimate loading needs to double-park and do their loading from the travel lane.

Methodology - Time-lapse photography was used to provide a visual record of before and after parking and traffic conditions on one of the blocks with the most obvious double-parking problems. Parking duration and turnover studies were performed both before and after the increase in enforcement.

Impacts on Double Parking - The impact of increased enforcement on double parking on Stockton Street is pictured on Figures 13 and 14 and summarized on Table 8. Stockton Street experienced a dramatic increase in the availability of on-street parking for trucks and a related reduction in double-parking as a result of the enforcement program. Evaluation of the time-lapse photography indicated that the number of double-parked vehicles on the west side of

(Reproduction from videotape)

Stockton Street Before Enforcement.

Figure 13

Stockton Street After Enforcement.

Figure 14

Stockton Street between Jackson Street and Pacific Avenue between 10:00 AM and 2:00 PM decreased from 78 vehicles "before" to 18 vehicles "after." The percentage of the time in which at least one vehicle was double parked on this block was reduced from 88 percent of the time "before" to 42 percent "after." Subsequent studies of this street showed that the double-parking problems quickly reappeared once enforcement efforts were relaxed.

Table 8

Impacts of Increased Enforcement
Stockton Street

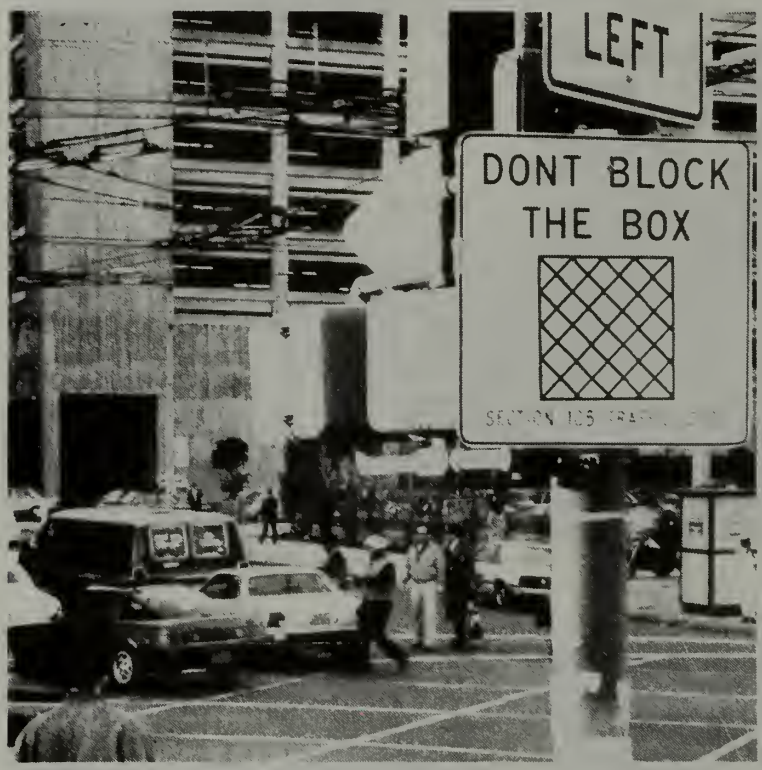
MEASURE	BEFORE	AFTER
Double-Parked Vehicles (1 blockface, 10 AM-2 PM)	78	18
Vehicles Parked 2 Hours or More (4 blockfaces, 10 AM-2 PM)	8	1
Vehicles Parked ½ Hour or Less (4 blockfaces, 10 AM-2 PM)	69	101

Impacts on Transit Speeds - Because no extreme back-ups were experienced by Muni vehicles on the "before" study day, no improvement in transit speeds was measured in this project. (Even with the constant double-parking, buses and other traffic were generally able to maneuver around the trucks during the midday period.) However, it appears reasonable to believe that a larger sample of "before" transit travel times would have included some cases of extreme delay caused by rampant double-parking. Had some of these delayed runs been included in the "before" sample, a reduction in the "after" travel time probably would have been realized. Thus, while the study indicated a direct relationship between enforcement and a reduction in double-parking, the relationship between enforcement and transit speeds appears to be direct only in the case of extreme congestion.

Intersection Blockage Enforcement Test

A test of the impacts of an enforcement program designed to reduce intersection blockage was performed at the intersection of Third and Mission Streets in the fall of 1986. The purpose of this test was to decrease traffic congestion caused by drivers entering congested intersections without being able to exit them, resulting in "gridlock" on downtown streets. Following the test of this concept at Third and Mission Streets, the program was expanded to fifteen other downtown intersecions. Enforcement activity at the intersection of Third and Mission Streets is shown on Figure 15.

The Problem - Several downtown and South of Market intersections were at times plagued by congestion caused by drivers who entered an intersection along a congested roadway even though downstream congestion prevented them from exiting the intersection. Vehicles thus became "trapped" in the intersection, blocking the progress of vehicles on the cross street once it received a green light. This problem was particularly severe at the Third and Market Streets intersection on Thursday and Friday afternoons between 4:30 and 5:30 P.M.



Intersection Blockage Enforcement at Third and Mission Streets.

Figure 15

Legislation - Section 105 of the City Traffic Code prohibits vehicles from entering an intersection "unless there is sufficient space on the other side of the intersection to accommodate the vehicle, notwithstanding any traffic control signal device indication to proceed." In June, 1986, the Mayor signed ordinance 209-68, which amended this section of the code in order to permit enforcement by civilian parking control officers by making intersection blockage a parking violation. In January, 1988, the State of California "Anti-Gridlock Act of 1987" (AB 667) went into effect, confirming local authority to enforce such intersection blockage regulations.

Signage and Markings - Just prior to the start of the enforcement effort, the Department of Public Works painted the intersection area with a distinctive cross-hatched box pattern and signed all approaches to the intersection with DON'T BLOCK THE BOX signage.

Enforcement - Beginning November 10, 1986, two SFPD parking control officers were assigned to the intersection of Third and Mission Streets Mondays through Fridays between 4:00 and 6:00 P.M. for a three week period. Officers issued written warnings for the first three days of the

enforcement effort, then began issuing citations to vehicles that were trapped in the intersection.

Impacts of Traffic Congestion - The impact of the intersection blockage enforcement program on traffic congestion is summarized on Table 9 and pictured on Figures 16 and 17. The enforcement program reduced the number of traffic signal cycles blocked by trapped vehicles between 4:30 and 5:30 P.M. from between 9-16 cycles on the three "before" Friday afternoons to between 2-4 traffic signal cycles on the three "after" Friday afternoons. Because traffic conditions appeared to be very similar on all six Friday afternoons, it appeared that the enforcement program could be credited with bringing about the reduction in intersection blockage.

Impacts on Transit Speeds - The impact of the intersection blockage program on transit speeds is also summarized on Table 9. Transit speeds were evaluated by timing westbound Muni and SamTrans buses on Mission Street over the block directly upstream of the Mission/Third intersection (between New Montgomery Street and Third Street). In the "before" evaluation, several cases of extreme congestion were recorded, with some buses requiring as long as four minutes, 35 seconds to travel this one 600-foot block because of congestion at the Mission/Third intersection. In the "after" evaluation, no bus required more than one minute, 52 seconds to travel this same distance. The project thus had the important effect of improving the reliability of transit speeds on this street by eliminating the unusually long travel times caused by extreme traffic congestion. The program has since been expanded to 14 other intersections and is regularly enforced during the evening commute period.

Table 9

Impacts of Increased Enforcement
Third and Mission Streets

DATE	NUMBER OF BLOCKED CYCLES	LONGEST BUS TRAVEL TIME*
Before Enforcement		
Friday, 10-24-86	9	2:30
Friday, 10-31-86	16	4:35
Friday, 11-7-86	13	2:44
After Enforcement		
Friday, 11-14-86	3	1:40
Friday, 11-21-86	2	1:52
Friday, 12-5-86	4	1:50

* From New Montgomery Street to Third Street.

(Reproduction from videotape)

Third and Mission Streets Before Enforcement.

Figure 16

Third and Mission Streets After Enforcement.

Figure 17

Conclusions

Conclusions regarding parking enforcement are summarized below. Improved parking enforcement can directly improve transit travel times in chronically congested locations. As congestion problems become more severe, the relationship between parking enforcement and transit speeds becomes more direct. The impact of improved enforcement on transit performance is often the elimination of the severe delays experienced by some trips, rather than a decrease in the travel time of all trips. Double-parking by loading trucks can be minimized through enforcement of curb parking space. Once enforcement efforts are discontinued, illegal parking quickly reappears. Finally, time-lapse motion pictures can be an effective means of demonstrating the effectiveness of parking enforcement programs and "selling" them to elected officials and the public.

CHAPTER FIVE

ADDITIONAL TPS ACCOMPLISHMENTS

This Chapter summarizes additional accomplishments of the TPS program between 1985 and 1988. These accomplishments include approvals for peak period left turn prohibitions on portions of Mission Street and for permanent bus bulb installations on Stockton Street; and an evaluation of the transit preferential measures on Sutter, Post, Geary and O'Farrell Streets east of Taylor Street which were implemented in 1982.

Mission Street Left Turn Prohibitions

In order to decrease general traffic congestion on Mission Street between 14th and Army Streets in San Francisco, the TPS program initiated Board of Supervisors Resolution 953-87, which prohibits left turns from Mission Street between 4-6 P.M. This project also includes a comprehensive review of curb parking restrictions on this section of Mission Street, and contains numerous recommendations to improve curb parking regulations which were supported by local merchants. Although approved in 1987 with the support of many area residents and merchants, this package of improvements has not yet been implemented.

Stockton Street Permanent Bus Bulb Installations

Temporary bus bulbs were installed along Stockton Street in Chinatown as a result of Board of Supervisors Resolutions 3-81 and 4-81. The bulbs were installed on a test basis using low-cost, temporary materials. The bulbs were found to decrease sidewalk congestion in this busy area by providing pedestrians with a place to wait for buses which is not in the path of other pedestrians walking along Stockton Street, and were also found to make it easier for buses to get to the curb (see Figure 18).

Stockton Street Bus Loading Platform Or "Bulb".

Figure 18

Before-and-after tests of the bus bulbs conducted in 1982 indicate an increase in bus speeds after their installation. However, some of this improvement was due to increased levels of parking enforcement during the "after" data collection stage, and a reduction in the number of bus stops also implemented as part of the project. Therefore, the impacts of the bus bulbs on Muni travel time were never isolated from other changes made as part of this program.

While the bus bulbs have generally been well received by Muni staff, Muni passengers, and the local community, the position of the bulbs opposite one another caused some delays to traffic when buses on either side of the street were stopped simultaneously. This condition often made it difficult for other traffic to maneuver around the stopped buses, particularly when one of the buses was unable to pull all the way over to the curb. This problem was addressed by the proposal shown on Figure 19, which staggers the bulbs so that they are not opposite one another. This proposal was approved by Board of Supervisors Ordinance 482-88.

Evaluation of 1982 Measures on Sutter, Post, Geary and O'Farrell Streets

In 1982, the Board of Supervisors approved a package of transit preferential improvements on downtown segments of Sutter, Post, Geary and O'Farrell Streets (Board of Supervisors Resolution 983-81). This package included all-day transit lanes on some blocks, mid-block bus loading bulbs at selected locations, bus stop relocations, curb parking reallocations, traffic signal timing changes, and the conversion of Grant Avenue from a two-way to one-way street between Market and Sutter Streets. These changes were evaluated by comparing eight speed-and-delay runs made on each street before the changes were put into effect in 1982 with eight runs made in 1985, following the completion of the cable car reconstruction through the study area in 1983 and 1984.

In general, the evaluation indicated mixed results, with transit travel times decreasing on some streets and increasing on others. The evaluation appeared to have several methodological problems, as the sample size appeared to be too small to evaluate on-street transit improvements in light of the wide variation in bus travel times through this area. Additionally, temporary downtown construction and street repair projects tended to make accurate before- and-after comparisons very diffucult even after the completion of the cable car reconstruction project.

Despite the methodological problems, the transit lanes appeared to be less effective than expected in improving transit speeds on these streets. On many blocks, it appeared that the transit lanes did not actually benefit the buses very much: buses generally trail the platoons of traffic created by traffic signals and often straddle the bus and adjacent general traffic lanes. On particularly congested blocks, the effectiveness of the transit lanes was reliant on adequate enforcement, which was not always present.

PROPOSAL FOR PERMANENT BUS LOADING PLATFORMS ON STOCKTON STREET

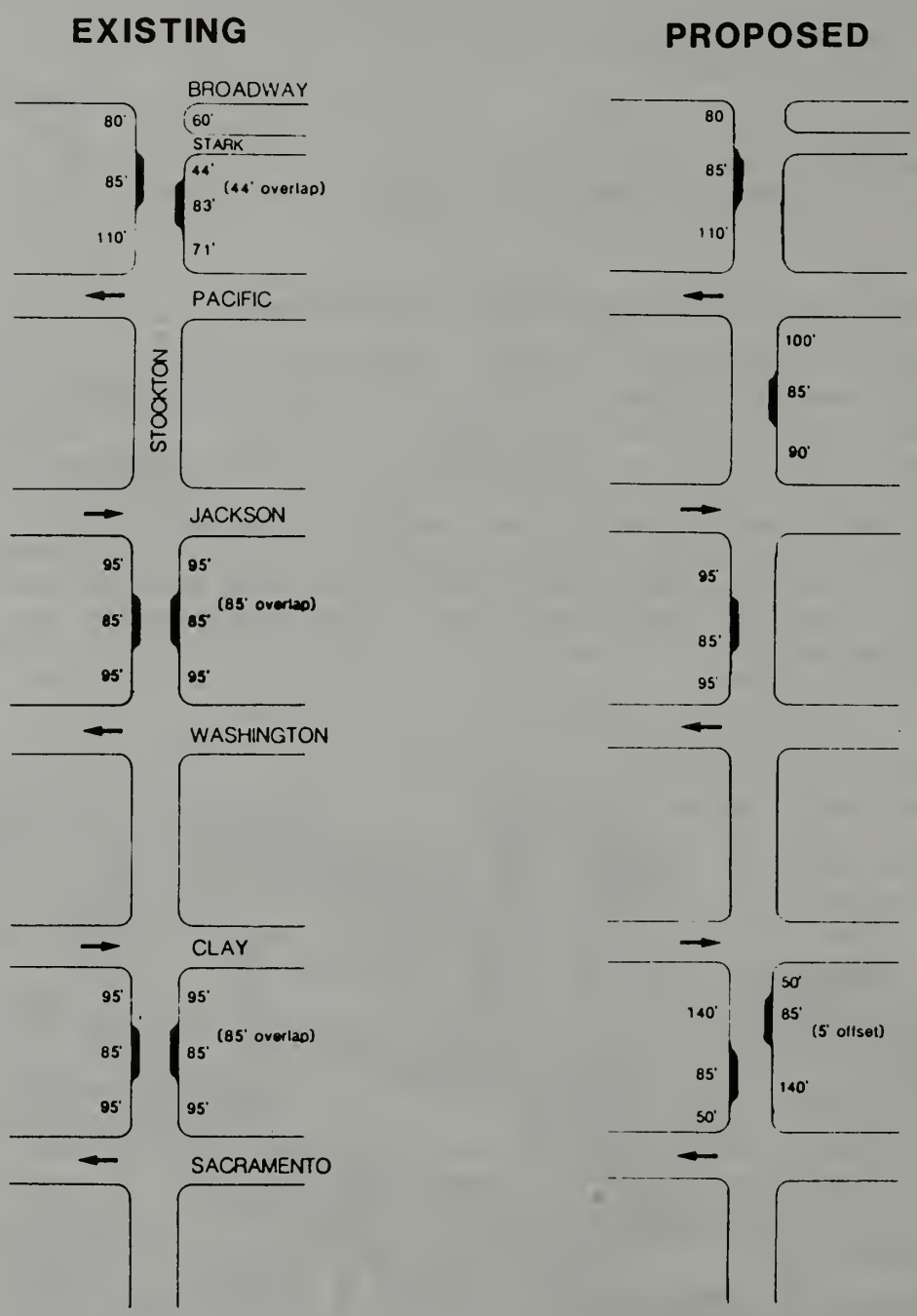


Figure 19

Conclusions

A variety of additional methods for reducing transit delays have been implemented in San Francisco, including bus-only lanes, bus loading "bulbs" and left turn prohibitions. The effectiveness of these measures has varied depending upon site-specific characteristics. Careful before-and-after evaluations are recommended in order to evaluate the effectiveness of these measures in given locations.

CHAPTER SIX

CONCLUSIONS AND RECOMMENDATIONS

This chapter summarizes the various findings made regarding measures to improve transit speeds in San Francisco as part of the Transit Preferential Streets Program. Conclusions and recommendations are grouped according to the chapter in which they are discussed in this report.

Reducing Transit Delays Through Bus Stop Reductions

Increasing the spacing between transit stops can be an effective measure in improving the productivity of transit routes, and can provide riders with a faster, more comfortable ride, although walking distances to and from stops are increased for some riders. Additional benefits can include decreased noise and air pollution from diesel buses and additional on-street parking availability. It is recommended that similar bus stop relocation and reduction projects be performed on other Muni routes where stop spacing does not conform to Muni policy. Candidate streets include:

Chestnut Street;
Eddy Street;
McAllister Street;
Hayes Street;
Clement Street;
Divisadero Street;
18th Street; and
Potrero Avenue.

Reducing Transit Delays Caused by Traffic Control Devices

Delays to transit caused by traffic control devices can be substantially reduced in a variety of ways. Along trolley bus and streetcar routes, traffic signals can be pre-empted through the installation of special equipment on the overhead lines. Through traffic signal systems, signal delay can be reduced somewhat through coordination of bus stop locations with traffic signal timings. At stop-sign controlled intersections, delays can be reduced by the removal of unwarranted stop signs, and by locating bus stops at the nearside of the intersection.

It is recommended that additional pre-emptions be installed along Muni trolley and streetcar routes where they will decrease Muni delays without presenting safety problems on cross streets. Candidate signalized intersections include Sacramento/Gough (1-California), Union/Fillmore (41-Union), Mission/Bosworth (14-Mission), Mission/17th Street (14-Mission 49-Ocean), and Sutter/Webster (3-Jackson, 4-Sutter). Additionally, new traffic signals equipped with pre-emptive devices could be installed at intersections which are currently controlled by stop signs. Candidate intersections for this treatment include West Portal/Vicente and West Portal/15th Avenue (K-Ingleside, M-Oceanview) and Duboce/Sanchez (N-Judah).

Improving Transit Speeds Through Parking Enforcement

Improved parking enforcement can directly improve transit travel times in chronically congested locations. As congestion problems become more severe, the relationship between parking enforcement and transit speeds becomes more direct. The impact of improved enforcement on transit performance is often the elimination of the severe delays experienced by some trips, rather than a decrease in the travel time of all trips. Double-parking by loading trucks can be minimized by better management and enforcement of curb parking space. Once enforcement efforts are discontinued, illegal parking quickly reappears. Time-lapse motion pictures can be an effective means of demonstrating the effectiveness of parking enforcement programs and "selling" them to elected officials and the public. It is recommended that parking regulations be strictly enforced on all San Francisco transit streets.

Additional Measures to Reduce Transit Delays

There is a wide variety of techniques that can be utilized to reduce transit delays in congested areas. These techniques should be closely monitered in order to gauge their effectiveness in individual locations.

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